

1P3

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Nice or Nasty

In this booklet we will be explaining our game, Nice or Nasty. We will give you an overview of our game and justification for its use. Following this will be the mathematical subject knowledge behind the game, as well as the pedagogical knowledge needed in order to maximise learning. We will also provide guidance to teachers on how to observe children's responses to the game and adaptations/extensions that could be put in place to make this game more inclusive as well as challenging.

Instructions

Adapted from a game from (Nrich Maths, 2017).

1. Players are arranged into pairs. Each team needs a grid with 3 boxes which will represent the H,T,U columns.
2. Each pair take turns to roll the dice and fill their boxes or choose to put the number in their opponent's box.
3. The team with the highest number overall wins.

Why play maths games?

Builds fluency

-Playing maths games allows children to demonstrate understanding of mathematical reasoning, whilst practising the maths that they have learnt. For example, in our game the placing of numbers is a good demonstration of the reasoning behind place value as every number a child places requires an understanding of what makes numbers larger than others (Rutherford, K. 2015).

-However, teachers must be wary that their games are engaging as well as getting the children to think strategically as opposed to luck. There is also a risk of upsetting children if they can't keep up with the speed of the game or they may be focusing on answering quickly rather than thinking through their reasoning.

Fun and motivating

-Playing maths games allows children to practice the maths they have learnt in a new context. It allows children to consolidate their own mathematical knowledge through play (Wikipedia, 2017).

Strategy

- Maths games allow children to use strategies to solve problems allowing them have a relational understanding of the maths they are using.
- By developing this strategic thinking it consequently guides children to manipulate methods to solve problems in different ways therefore giving them relational learning.

Assessment

- Maths games are a good platform for formative assessment, where the child can successfully participate in a maths game they demonstrate they understand the maths and reasoning behind it. This can be confirmed in our game by asking the children why they put numbers in certain places and why they use certain strategies to win.

Can support link with parents by playing game at home

- Children teaching a game to their parents at home gives an opportunity to improve their number fluency outside of school. Additionally it strengthens the school to home relationship by making parents aware of what their children are learning(Maths games and activities, 2017).

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How the 3 key aims of the National Curriculum are met by Nice or Nasty

Problem solving

Often problem solving is accompanied by a rationale or a 'story', putting the mathematical theory into practice as well as an applied context. Fundamentally we only learn maths so we can apply it to solving problems. Problem solving is where creativity thrives and can be enjoyed through sparking curiosity. In our game the children use their ability to solve problems by balancing their own gains with sabotaging their opponents(GOV.UK, 2017).

Reasoning

Reasoning is the process of children understanding the logical principles governing mathematics. In our game the children must understand that columns represent thousands, hundreds, tens and units. Numbers are placed strategically to make a bigger number. This demonstrates an understanding of what makes a number larger or smaller. They also show reasoning when deciding to steal or sabotage their opponents numbers. Both reasoning and problem solving involve a great deal of strategy in playing Nice or Nasty(Education Endowment Foundation, 2017).

Fluency

Fundamentally mathematical fluency comes down to 3 different things, efficiency, accuracy and flexibility(Russell, 2000). Efficiency is developing strategies that show working and reasoning but not being time consuming and ineffective. Accuracy is being able to check answers against prior knowledge and be able to record data accurately. Lastly, flexibility is the ability to carefully select methods and skills appropriately to answer questions. Every time the child rolls the dice and places a number in their grid they are practicing their fluency. They use their accuracy to check the numbers in their grid are in the right places. They show flexibility deciding whether to steal or sabotage their opponents as well as placing a number in their own grid. With every roll of the dice the children are practicing the place value of numbers(Gospel Oak, 2017).

Mathematical subject knowledge

The key ideas in place value

Column value – Column value is an important concept for children to grasp. This game can help children to develop their column value skills through getting them to place the numbers into a grid labelled units, tens, hundreds, thousands etc. “children need to realise that in mathematics we impose an invisible column structure on multi-digit numbers” (Thompson, 2017).

Base 10-

When we count we use the number 10 as a base and all numbers are shown using a finite set of digits which are 0,1,2,3,4,5,6,7,8,9. Whole numbers bigger than 9 are constructed using powers of the base: ten, a hundred and a thousand (Haylock, 2014 p.72). The idea of base 10 can be applied to the nice or nasty game because children will be able to use their mathematical knowledge of base 10 allowing them to place the numbers in the most suitable box to win the game.

Grouping and exchanging-

Although grouping and exchanging is not directly linked to the nice or nasty game, they may need this background subject knowledge to be successful in the game. Exchanging is idea of “exchange one of these for ten of those” (Haylock,2014 p.73). This a key aspect part of place-value and addition because it gives children the mathematical knowledge when carrying out column addition with the idea of ‘carrying one’.

The position of a digit determines its value-

Children need to have a good mathematical understanding that digits have different values when placed in different columns. Children need to gain an understanding that “It is always the first digit in a numeral that is most significant in determining the size of a number” (Haylock, 2014 p.78). For example, children need to have an understanding that if they put the digit 2 in the ones column it has a different value to if they put it in the thousands column.

Zero as a placeholder-

“The function of the zeros is to make this position clear whilst indicating that there are no tens and no one's” (Haylock, 2014 p.77). Zero as a placeholder is the idea that zero in a number is there to represent there is no value in that column and additionally to show the position of a number. In the game children, will need a mathematical understanding of this principle so that if they get a zero they know it has no value in the column they put it in but it can be used as a place holder. For example, to win the nasty version of the game children may have the knowledge to put the zero in the highest value column of their opposition.

Only 10 digits-

This principle is the understanding that our number system has only 10 digits which we can use to make any number. These digits are 0,1,2,3,4,5,6,7,8,9. Children can apply this place-value principle to the game because the game uses the digits on a dice to create a new number made up of the different digits they roll on the dice.

Does this game inter-relate across topics?

The nice or nasty game can relate to the idea of ordinal value. Ordinal value is the idea of children learning numbers through using them as labels to put things in order (Haylock, 2014 p.66). Number lines are an important aspect of ordinal value. The game relates the ordinal value because children need to understand the order and value of numbers, for example 9 is greater than 1 to be successful in the game. Whereas cardinal value is usually a child's first experience of numbers. Cardinal value "is the idea of a number being a description of a set of things" (Haylock, 2014 p.66).

This game can also link with addition. Addition can use many place-value principles that are reinforced in nice or nasty game. A good example of addition using place value principles is grouping and exchanging, because it allows children to have the mathematical knowledge when carrying out column addition with the idea of 'carrying one'. The position of a digit determines its value can also have an impact on addition because children need to understand the value of numbers to add them and carry out addition methods.

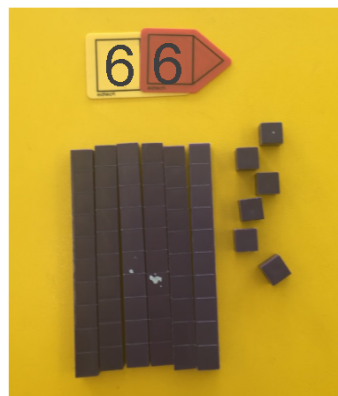
Opportunities for mathematical reasoning?

The nasty version of this game, gives children lots of opportunity to apply their mathematical reasoning skills to gain advantage. They can apply their mathematical knowledge of the position of a digit and how it determines its value, in order to make their oppositions number the lowest possible to win the game. This is because if they know to put 1 in the thousands column it instantly makes it a lower number.

Pedagogic knowledge

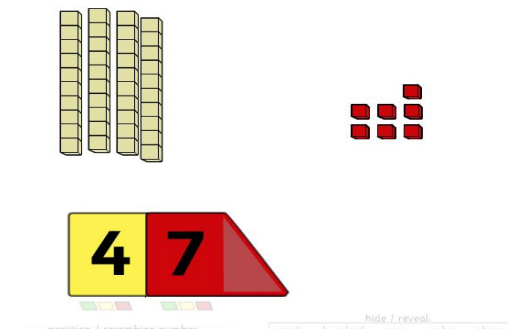
”Real learning can only occur when the pupil is actively engaged in operating on or processing learning experiences facilitated by the teacher through play and active experimentation”(carroll 2014). This is why we have created a fun and engaging game. Our game uses a variety of Bruner’s modes of representation. This is because “The underlying tenet of constructivism is that a learner must construct meaning for himself or herself rather than being a passive recipient”(Delaney 2001).

For all children to actively engage in the game we have used a range of resources to support their learning. For younger children and children who are finding place value hard to understand, we have chosen dienes because “the enactive mode involves representing mathematical ideas or structures by means of actions, such as manipulating physical apparatus” and “They have strong visual and tactile appeal that relates well to how children learn.” (Delaney 2001). Dienes are particularly useful as you can see the physical difference of size in the two numbers and therefore allows easy comparison of numbers. The use of dienes also “enable teachers to follow and interact with children’s thinking more directly” (Delaney 2001). This will be useful to see who has grasped the idea of place value and who may need more support to gain relational understanding.



We will also be using arrow cards with all learners because “children learn to relate the number symbols, and order, to the acoustic and concrete images that they have experienced”(Drews 2007) this helps deepen their understanding. The use of arrow cards help to scaffold children’s learning.

For children with severe visual impairment who may not be able to see dienes to be able to use them effectively, we will encourage them to use the resource

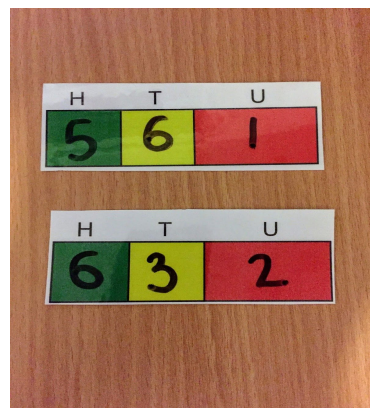


found at http://www.ictgames.com/arrowCards_revised_v6.html

This is an amazing website where you choose the value of the arrow cards and it automatically represents the number in dienes above the arrow cards. This will be a great resource to use to include everybody in the lesson as you could use it on the Interactive whiteboard.

We have chosen to use H,T,U grids in our game, to help all children remember the importance for place value. Some children will have H,T,U labels above the grids. The H,T,U labels are Symbolic as they are “representation through words or language” (Delaney 2001). Symbolic resources are useful for children who already have some understanding.

Children who are confident with place value will still use the grid however there they won't need H,T,U written above the box.



Questions that teachers should ask to articulate reasoning

Adey and Shayer said that there are 6 key steps to Cognitive acceleration, these are; “Concrete preparation, cognitive conflict, construction, metacognition and bridging” (McGregor 2007) “Construction is drawn from Vygotsky’s (1978) concept of the ZPD, developed through social exchange”(McGregor 2007). Social exchange helps deepen

understanding and therefore it is vital that children explain their reasoning and strategies to their peers as well as adults. Therefore teachers should be asking thought provoking questions to help children articulate their mathematical reasoning, this will also help to highlight any children who may need more support with their understanding of place value.

“Relational learning are practices that invite both students and teachers/professors to enter into a dialogue about learning”(taosinstitute) By the teacher asking questions and children having time to talk in pairs, this creates relational understanding. Relational learning is “knowing both what to do and why” (skemp) Which is more effective for lifelong learning than instrumental which can be described as “rules without reasons”(skemp), this means children won't be able to apply their knowledge. Relational understanding therefore equips children with an understanding that allows them to apply their knowledge into practise.

Description of how children could collaborate to play the game and the rationale of this

“Effective learning requires meaningful, open-ended, challenging problems for the learner to solve”(Fox 2001). We have created a game that has allows children to work independently but with the support of their partner. We have decided a 1:1 game will be best as it allows all children to justify the reasoning behind their decision and this supports children that may normally shy away from group discussion. “The acquisition of language can provide a paradigm for the entire problem of the relation between learning and development”(Vygotsky, 1978). When children work together they are able to ensure that they both understand the mathematical principles as they will be able to

explain their reasoning to each-other. This is also a good chance to support children who need more help in their mathematical understanding. Therefore it is really important that children share their ideas with their peers as well as teachers to deepen their mathematical understanding.

Guidance for teachers

In order to reflect on the extent of learning made by the children in our game, it is important for teachers to know what to look and listen for.

Teachers can do this through observing children playing the game and looking to see if they have any strategies that they use or express any reasoning behind their decisions. It is also helpful in terms of assessing children on what they know and finding out their strengths and weaknesses. McLeod(2008) says observations are linked to Bruner as they allow teachers to support children and their needs and 'scaffold' their learning by looking to see what they know and giving 'structured interaction'.

When our game was played in one of our placement settings, the student teacher noticed how some of the children in her group were able to strategically play the game and learnt that if they rolled a 5 or 6 on their first go, it made sense for them to put that number in the tens column as they knew it was a 6 sided dice, and that they are both high numbers. This shows how some children were able to reason mathematically as they discussed with their opponent why they placed their number where they did. This directly links with the aims of the National curriculum (2014), as it asks to ensure that all

pupils “reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language”. Observations are a fantastic way to assess and look at whether the children have understood the game and the extent of whether they have met all, or some, of the learning objectives set at the beginning.

The teacher could also use questions to elicit reasoning responses from the children whilst they are playing which would encourage them to think about how best to place their numbers, meaning they are more likely to win the game. Way (2001) suggests that questioning is the ‘fundamental tool’ to being a successful teacher highlighting the importance of questioning. Badham (2014) suggests there are various types of questions that can guide children in maths.

For example, using questions such as :

- What happens when we ?
- How did you find that out?
- Why do you think that?
- What made you decide to do it that way?

Questions enable children to think about what it is they are doing that is helping them win and should be encouraged to use phrases such as;

- ‘ I know this... so’
- ‘ It must be because’

- ‘ If....then...

By questioning children, you are able to assess the extent of their learning which links to one of the key aims written into the National Curriculum (2014) of ‘Fluency’. Russell (2000) suggests fluency is made up of ‘efficiency, accuracy and flexibility’ and that for a child to have this they need to be to not only perform the task but understand how and why they are doing it, as well as when it is appropriate to use. The national curriculum also states that for a child to have fluency they need to have ‘frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.’ In order to allow children to show this, it may be useful to play the game weekly in order to build their “conceptual understanding” and “recall” what they learnt the previous week. When playing the game on placement, the children were able to use their existing knowledge about place value allowing them to apply what they already knew to the game, suggesting most met with the national curriculum aim of having fluency.

Teachers should also look to see how the children are using the resources and whether they understand how they can be used to aid them in beating their opponent. Delaney (2001) supports this as he suggests resources allow children to “demonstrate what they are trying to express” and that maths is relatively difficult to teach without “visual or manipulative aids of some kind”. Resources also allow children to become more confident with problem solving as they are able have a visual representation in front of them giving them more confidence when making decisions on how they can get the

biggest/smallest number. Mclure(2013) suggests the whole of maths is based on being able to solve problems so it is important that children are given this opportunity and are provided with ways that can aid them in reaching a solution. The use of resources also allows teachers to record and see evidence that the children do understand and can be useful when providing evidence for assessing that child's learning as Bruner suggests that symbolic representations achieve 'fuller understanding'.

Adaptions

Adaptations can be made to suit the individual needs of the class.

- Level of difficulty

Higher

- Adding a decimal place
- More digits.
- Challenge to make a specific number.
- Play for points, the biggest number each round gets a point.
- Make the smallest number.

Lower

- Less digits. Eg. 2 digit number for KS1 between 1-20 as stated in the National Curriculum.

- Removing the 'nasty' aspect of the game.
- Use a 1-6 dice rather than 0-9.
- Pair up groups so children can support each other's learning through playing the game. This links to Vygotsky's more knowledgeable other which can help to scaffold their relational understanding.

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Time/plac e	Review of progress since last meeting	Summary of today's discussion	Post meeting task allocation	Members present
8.2.17		All brought along a game idea. Decided on an addition game.	Think about what resources might be useful and how they might be differentiated for different needs.	Jasmine Alice Katie helen
15.2.17	Decided on what resources we need and how we are going to make them.	How to differentiate the game for different children.	Bring resources to next meeting.	Jasmine Katie Alice Helen
22.2.17	Lovely to see alicé's resources Talked about how we can apply this to placement.	Went through section 8 of the booklet talked microteach.	Look at evaluation of microteach and how we can use this at placement.	Jasmine Katie Alice Helen
9.3.17	Bring any issues to discuss.	Made sure everybody was happy with their part and that they would have it ready for next session. Alice maths subject knowledge	Katie to add quotes to back her ideas up. EVERYBODY to bring their work completed to our next meeting so we can put them all together.	Helen Alice Katie Jasmine

		<p>Katie teachers guidance</p> <p>Jas pedagogic</p> <p>Helen adaptations and introduction.</p>		
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16.3.17	<p>Katie, alice and jas brought completed work along. Helen did not.</p>	<p>Katie and alice added quotes to back up their points.</p> <p>Put all work into a google document and read through highlighting any areas for development.</p>	<p>Helen to have completed her part (instructions, introduction and differentiation) by sunday evening.</p> <p>Alice and Katie to have completed all quotes.</p> <p>Jas to alphabetise the reference list.</p> <p>Everyone to have completed their work ready to put it all together on thursday the 23rd march.</p> <p>All work should be ready to hand in at the end of this lesson.</p>	<p>Alice</p> <p>Katie</p> <p>Jasmine</p>
23.3.17	<p>Helen came 25 minutes late with unfinished work.</p>	<p>Helen continued writing her work that was meant to be finished on arrival.</p> <p>Alice found a quote to back up her statement.</p>	<p>Helen to have work completed by sunday.</p> <p>Jas to proofread before group proofreading session.</p>	<p>Jas</p> <p>Katie</p> <p>Alice</p>

		Jas did the reference list. Katie proofread her section.		Helen 25 minutes late
28.3.17		jas spent an hour proofreading and editing Helen's work, as we had gone through everybody else's work in the last session.		
30.3.17		Alice, jas and Katie proofread the whole document. Editing the work so it was ready to hand in. 3 hours	All upload work to turnitin	Alice Katie Jas Helen was absent